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Fukushima

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(54) **PILOT CHECK VALVE**

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F16K 15/02 (2006.01)
F15B 13/02 (2006.01)

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CPC ***F16K 15/1826*** (2021.08); ***F15B 13/027*** (2013.01); ***F16K 15/021*** (2013.01); ***F16K 15/026*** (2013.01)

(58) **Field of Classification Search**
CPC ... F16K 15/182; F16K 15/1826; F15B 13/027
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,631,888 A * 1/1972 Anton F15B 13/015 251/63.4
10,480,542 B2 * 11/2019 Bell F15B 15/202
2004/0112208 A1 * 6/2004 Kot, II F15B 13/01 91/420

FOREIGN PATENT DOCUMENTS

JP 2018-9662 A 1/2018

OTHER PUBLICATIONS

Machine translation of JP 2018009662.*

* cited by examiner

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(57) **ABSTRACT**

[Solution] A pilot check valve includes a first body that has input and output ports, a main path **13** that is in communication these ports, and a check valve element that allows a flow of a pressure fluid from the input port toward the output port. The valve element blocks or allows a flow toward the input port side by supply or discharge of a pilot fluid and has a residual pressure exhaust path connected between the main path and an exhaust hole, a seal member that is provided in the exhaust path, and a push rod that moves the check valve element to a position where a flow of a pressure fluid toward the input port side in the main path is allowed and moves the seal member to a position where a flow toward the exhaust hole is allowed.

10 Claims, 9 Drawing Sheets

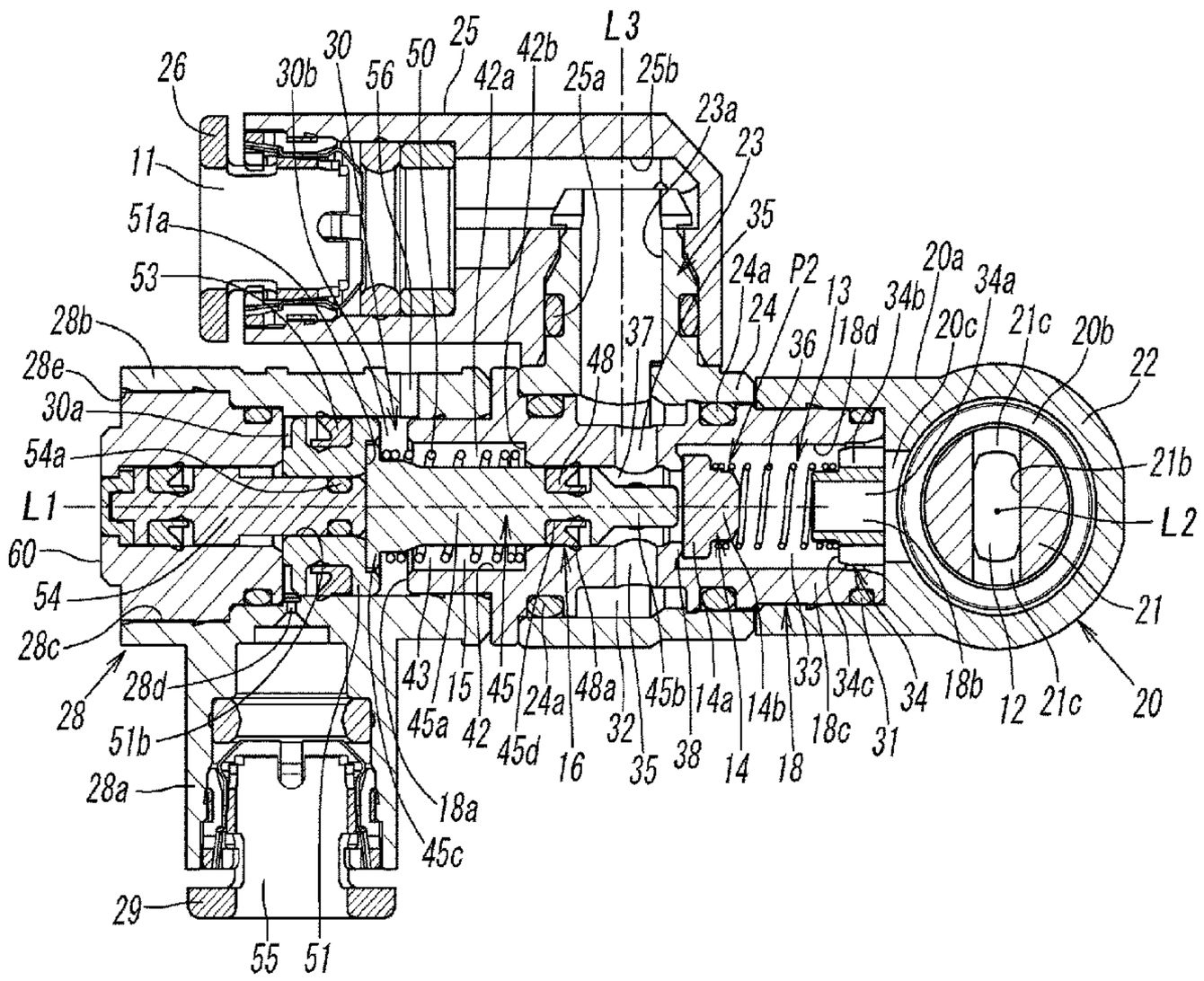


FIG. 1

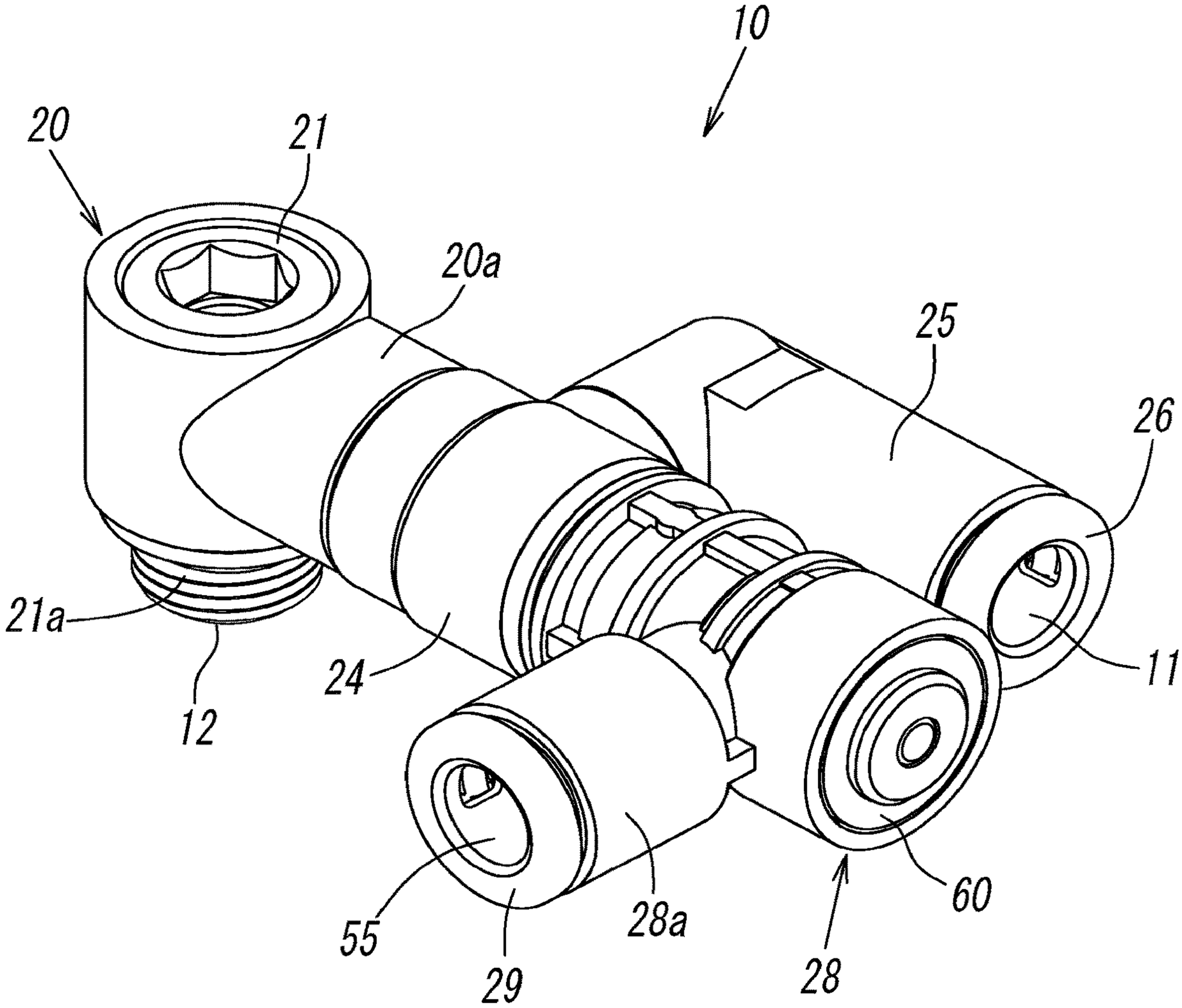
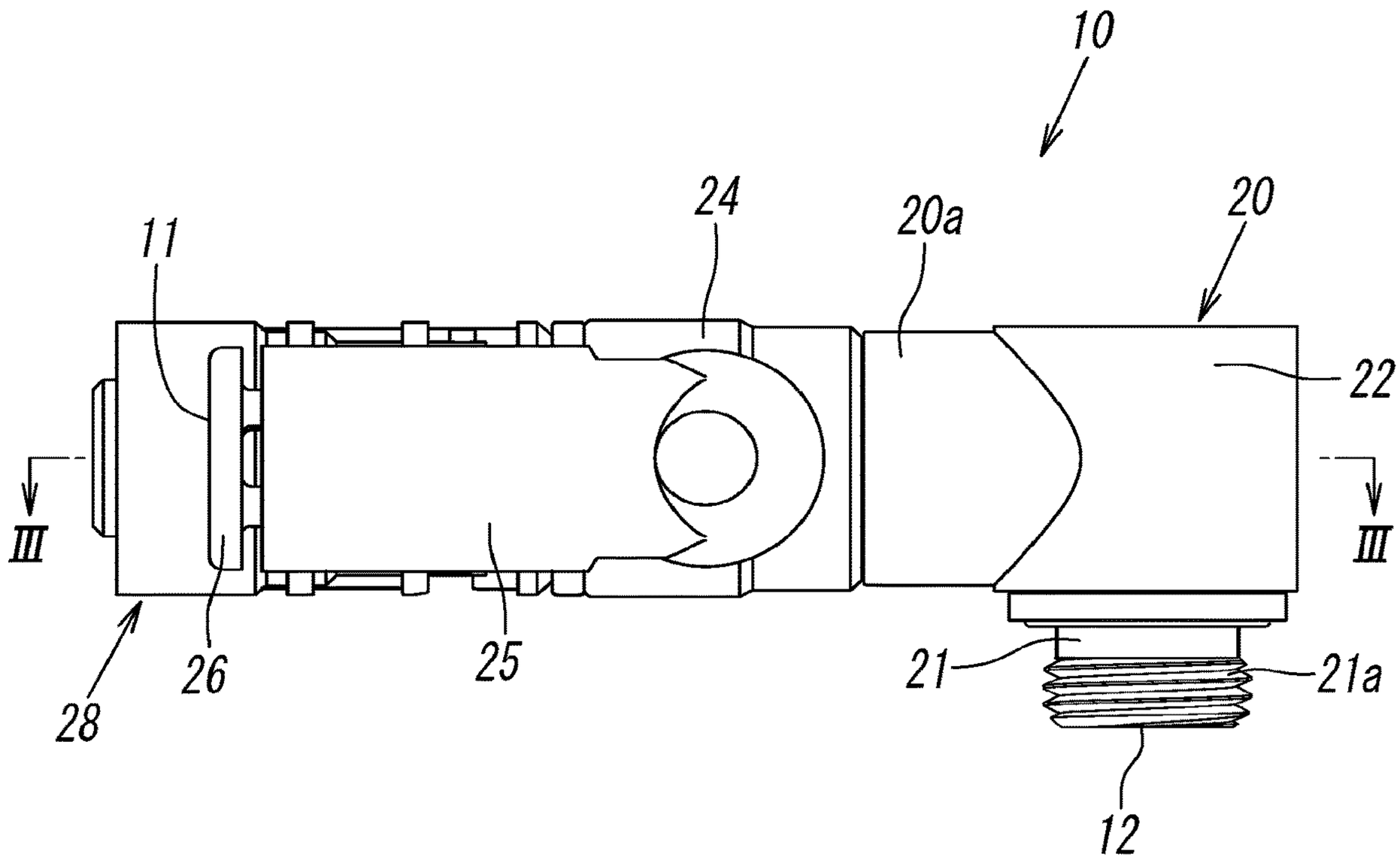
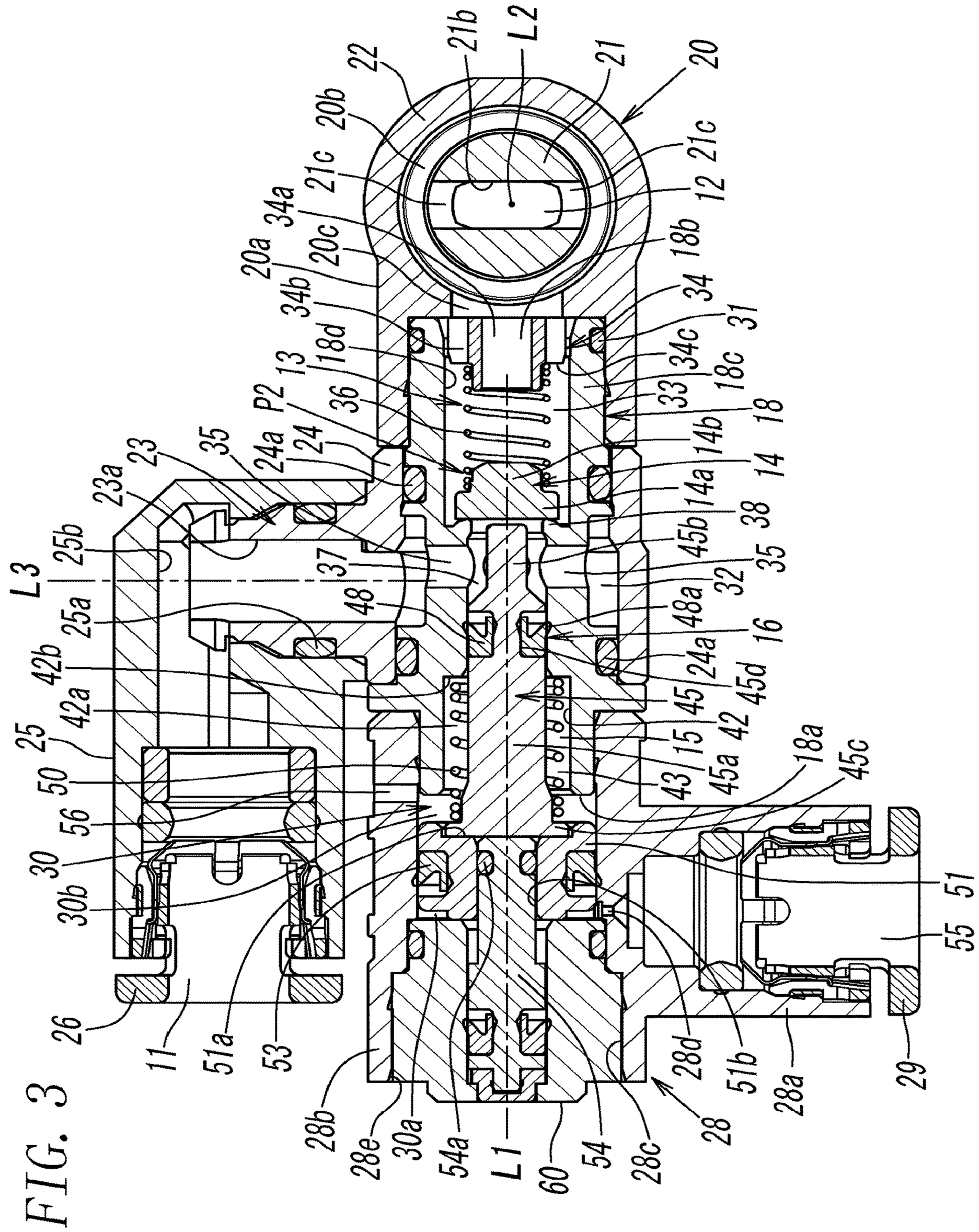


FIG. 2

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20b
21c
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51
55
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FIG. 3

FIG. 4

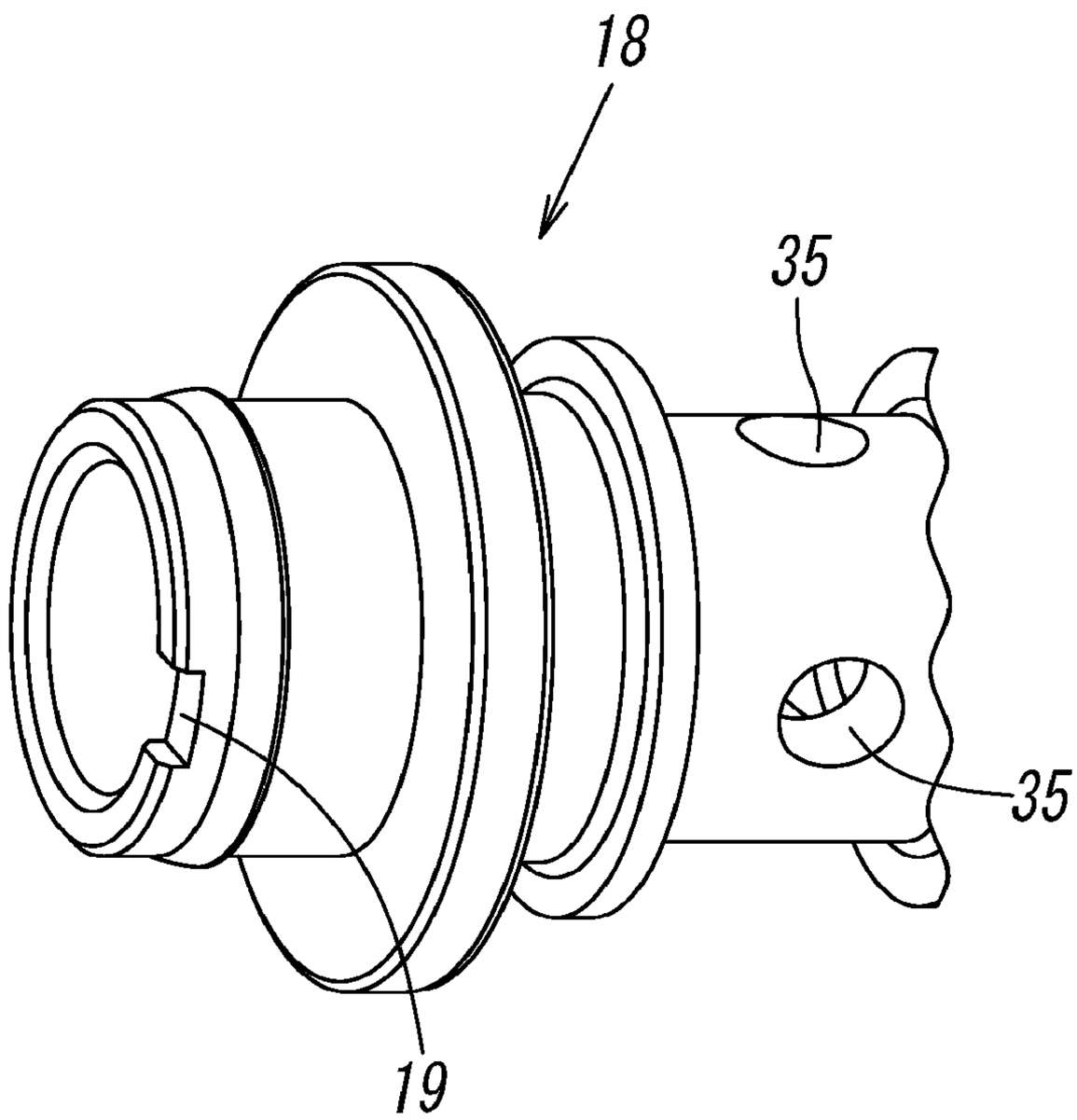

FIG. 5

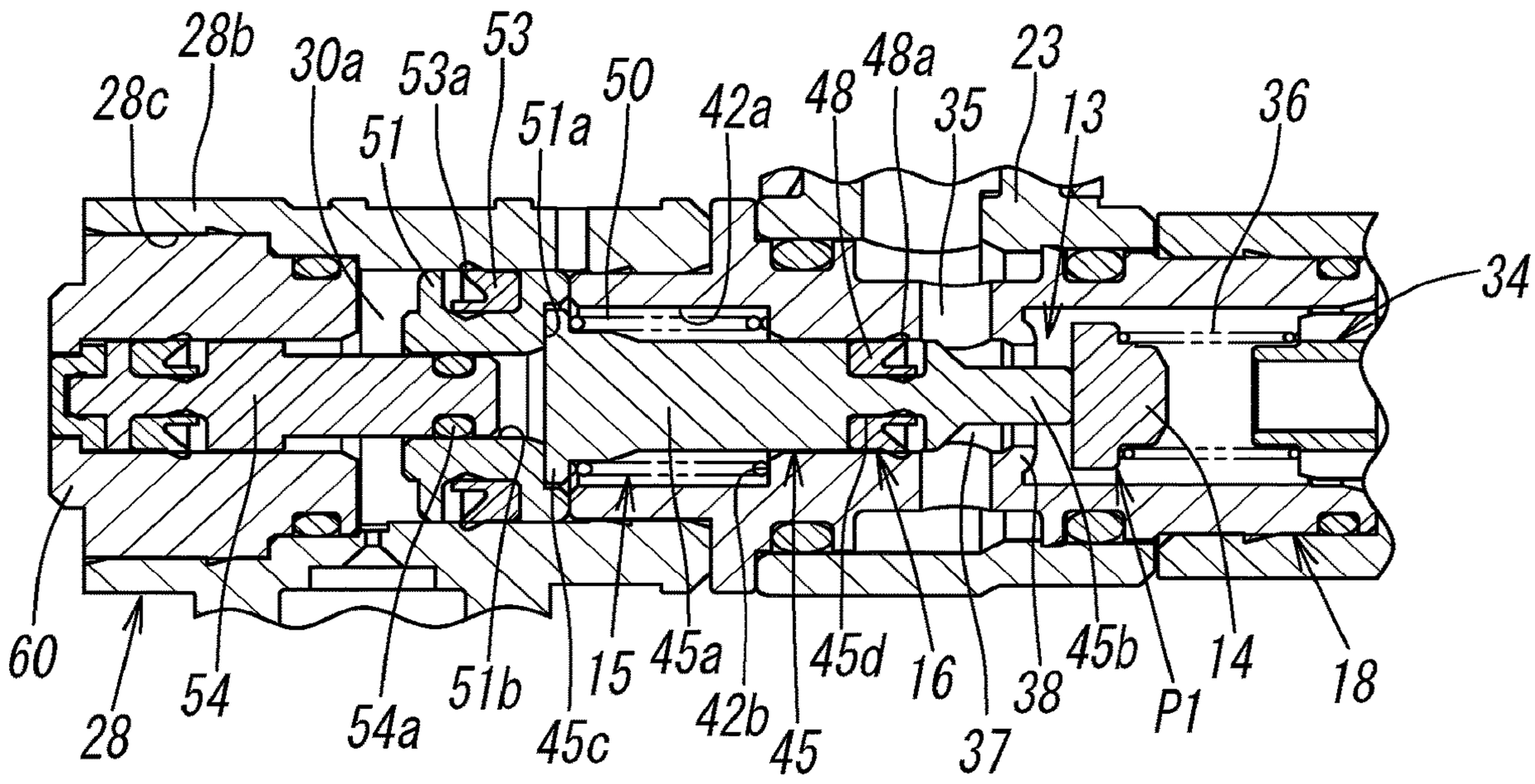
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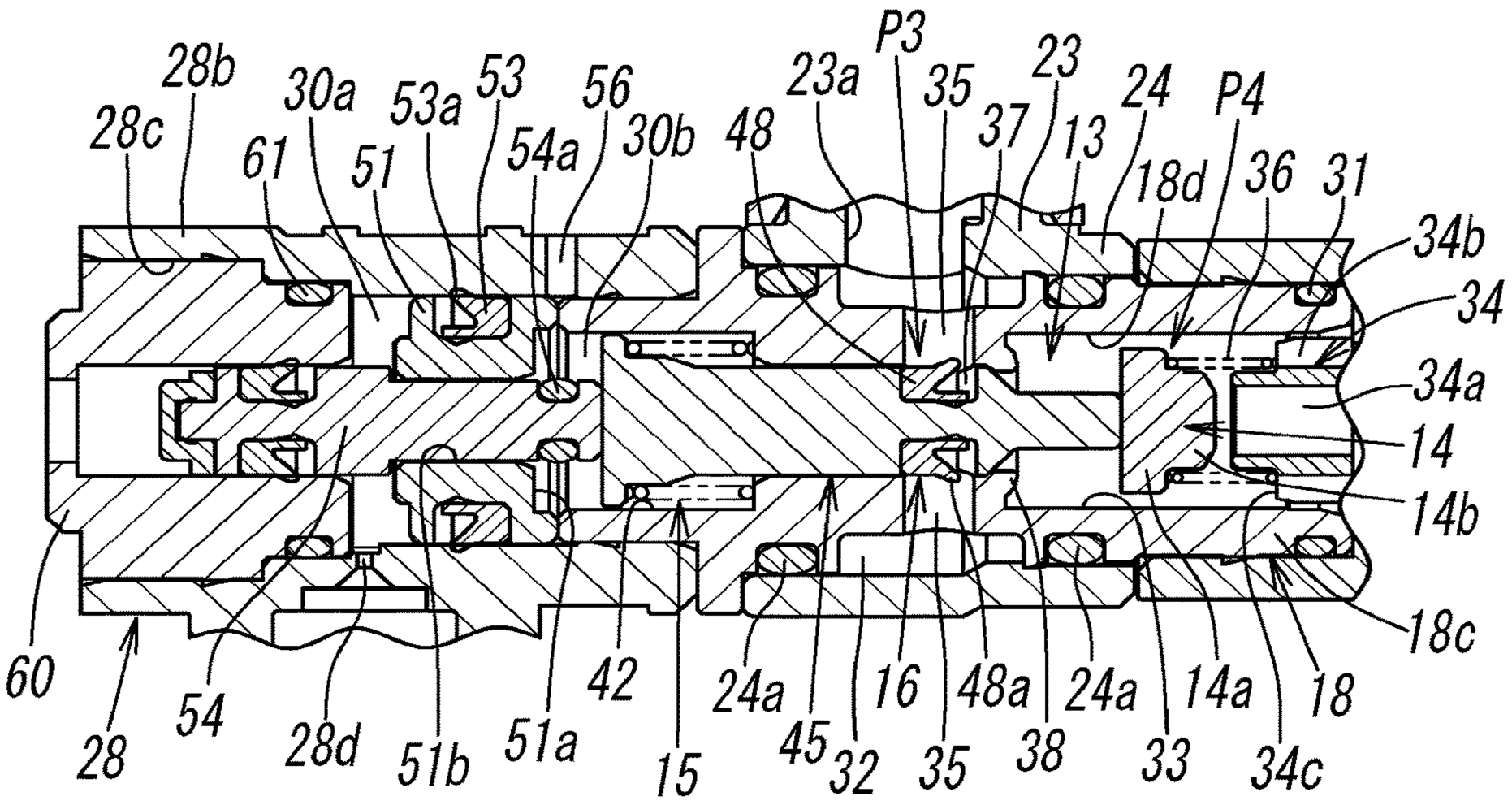
FIG. 6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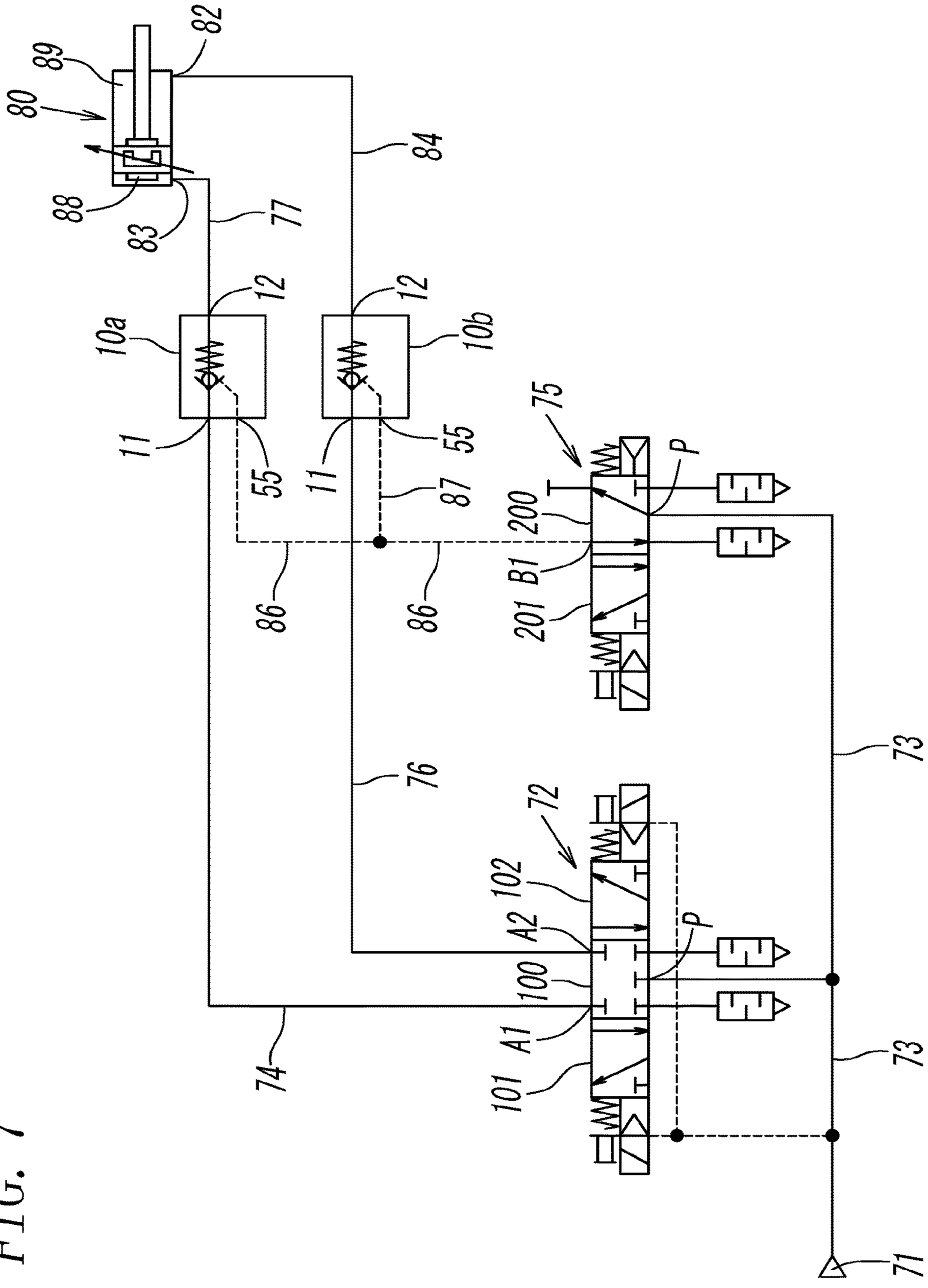
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FIG. 7

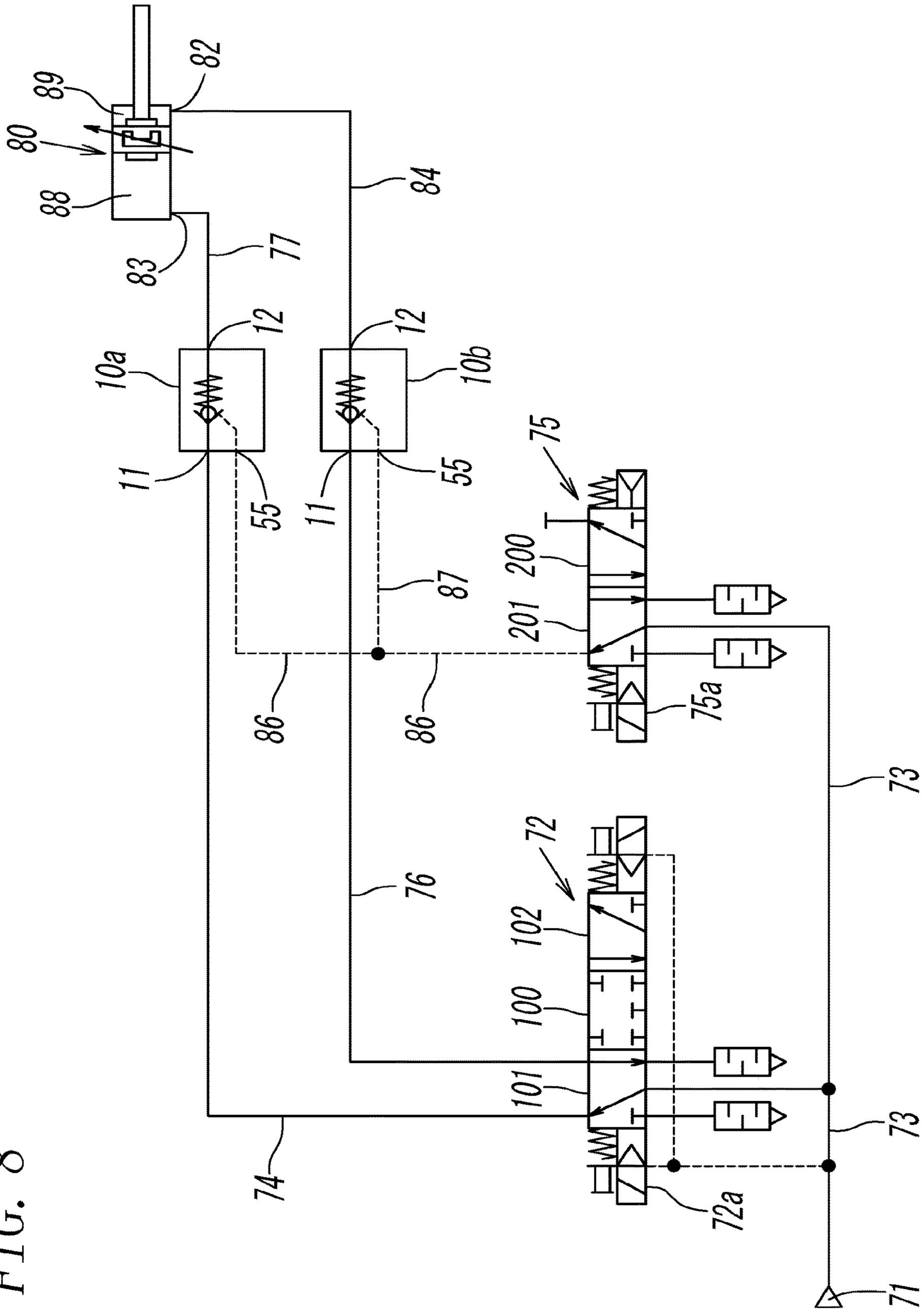
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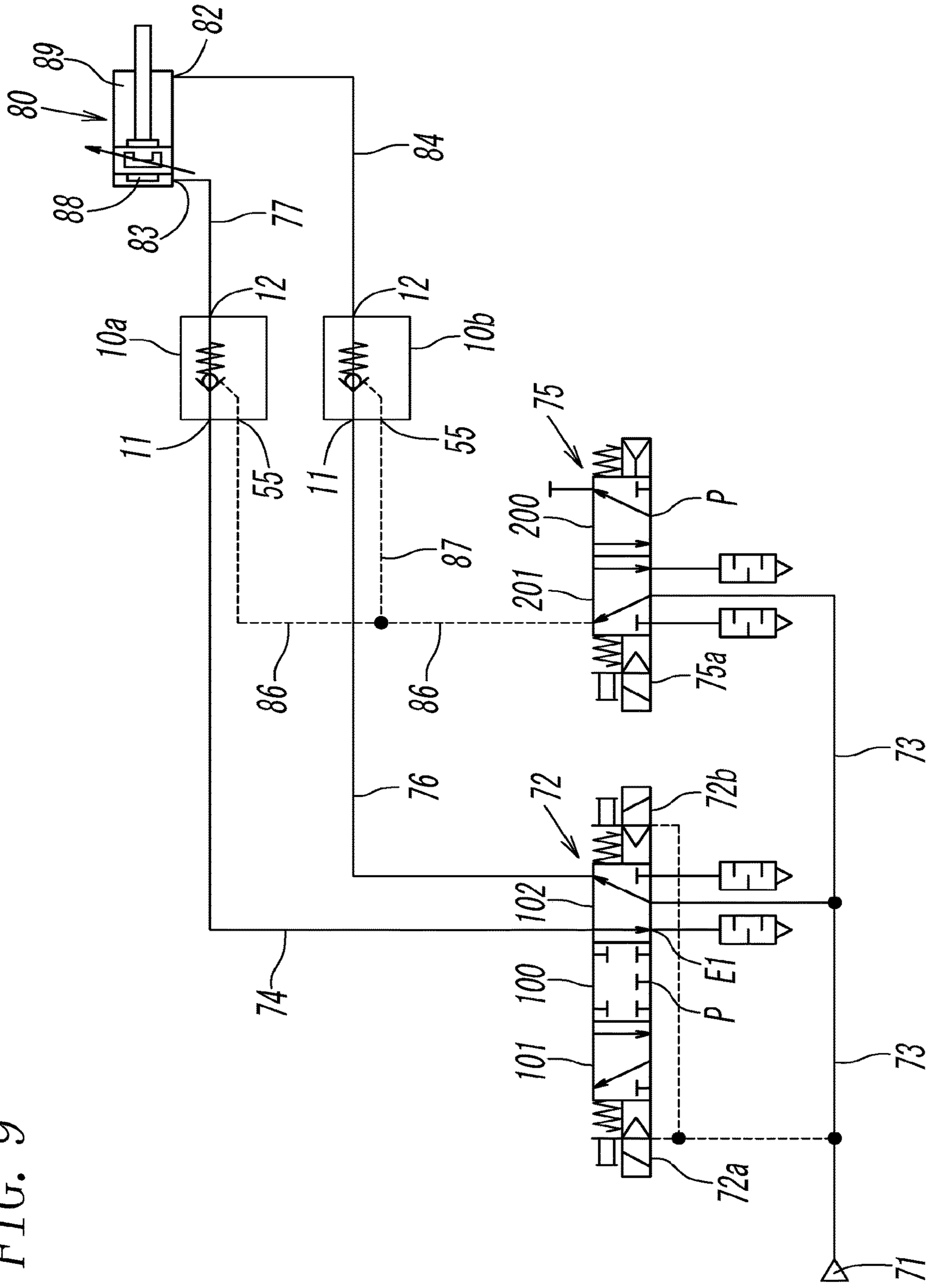
FIG. 8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75a
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72b
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E1
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FIG. 9

PILOT CHECK VALVE

TECHNICAL FIELD

The present invention relates to a pilot check valve having a residual pressure exhaust function that discharges residual pressure in a fluid pressure device such as a fluid pressure cylinder.

BACKGROUND ART

A pilot check valve according to the related art has been known as described in Patent Literature 1. The pilot check valve includes an input port for connecting to a pressure fluid source, an output port for connecting to a fluid pressure device such as a fluid pressure cylinder, a main path that connects the input port to the output port, and a check valve element that is provided in the main path, allows a flow of a fluid from the input port toward the output port, and can be selectively moved, by supply or discharge of pilot air, between a first position where a flow from the output port toward the input port is blocked and a second position where the flow is allowed.

Here, the pilot check valve described in Patent Literature 1 is provided with a residual pressure exhaust unit that can exhaust a pressure fluid (residual pressure) sealed in the fluid pressure device from an exhaust hole to the outside through a residual pressure exhaust path where necessary, when the fluid pressure device stops by any cause. The residual pressure exhaust unit has a valve element that is opened/closed by supply or discharge of pilot air. When pressure of the pilot air is applied, the valve element blocks a flow of a pressure fluid from the output port toward the exhaust hole through the residual pressure exhaust path.

However, in a pilot check valve with a residual pressure exhaust valve according to the related art as described above, since the residual pressure exhaust path is connected to the main path downstream of the check valve element on the output port side, if a failure occurs in the sealing property by the valve element in the residual pressure exhaust unit, in case of an emergency such as stopping of power supply, the pressure fluid that is supposed to be sealed in the fluid pressure device may be exhausted to the outside from the exhaust hole through the residual pressure exhaust path. In such a case, the check function of the check valve element provided in the main path may be lost.

CITATION LIST

Patent Literature

[PTL 1]: Japanese Unexamined Patent Application Publication No. 2018-9662

SUMMARY OF INVENTION

Technical Problem

A technical issue of the present invention is to provide a pilot check valve that is capable of holding there a pressure fluid sealed downstream of a check valve element by a check function of the check valve element in case of an emergency such as stopping of power supply, even if a failure occurs in the sealing property by a valve element in a residual pressure exhaust unit.

Solution to Problem

The present invention provides a pilot check valve including a first body that has an input port and an output port, a main path that is provided in the first body and is in communication with the input port and the output port, a check valve element that is provided in the main path and allows a flow of a pressure fluid from a first side in communication with the input port toward a second side in communication with the output port, the check valve element being selectively moved, by supply or discharge of a pilot fluid, to a position where a flow from the output port toward the input port is blocked and a position where the flow is allowed, a residual pressure exhaust path having one end connected to a connecting portion formed on the first side of the main path and another end connected to an exhaust hole provided and opened on the first body, a seal portion that is provided in the residual pressure exhaust path and blocks a flow of a pressure fluid from the connecting portion of the main path toward a side of the exhaust hole, and an operation unit that is capable of moving the check valve element to a position where a flow of a pressure fluid from the second side toward the first side in the main path is allowed and moving the seal portion to a position where the flow of a pressure fluid from the connecting portion of the main path in the residual pressure exhaust path toward the exhaust hole is allowed.

In this case, it is preferable that the first body extends in an axial direction, is formed into a cylindrical shape, and has a base end and a leading end at both ends in the axial direction, the first body has a through-hole that extends inside in the axial direction, the first body has a first opening portion that opens in a middle portion of the first body in the axial direction and that is in communication with the input port, and a second opening portion that opens in a base end portion of the first body in the axial direction and that is in communication with the output port, the check valve element is supported and is movable in the axial direction in a base end portion in the axial direction of the through-hole extending in the axial direction, and the operation unit is accommodated in the through-hole further toward a leading end side than the check valve element in the axial direction and is movable in the axial direction.

In addition, it is preferable that the operation unit is a rod member that extends along the through-hole, the rod member has an outer diameter that is smaller than an inner diameter of the through-hole, and the residual pressure exhaust path is formed of a gap formed between an outer peripheral surface of the rod member and an inner peripheral surface of the through-hole.

In addition, it is preferable that the seal portion has a recessed groove that is formed into an annular shape on the outer peripheral surface of the rod member, and a seal member that is accommodated in the recessed groove, and the seal member is a lip-type seal member, the seal member having a lip portion that is formed to be inclined outward in a radial direction toward a base end side in the axial direction.

In addition, it is preferable that a part of the through-hole in communication with the first opening portion and the second opening portion forms a part of the main path, the base end portion in the axial direction of the through-hole extending in the axial direction has a valve seat on which the check valve element is capable of abutting, and the check valve element is capable of moving to a check position where the check valve element abuts on the valve seat and blocks a flow of a pressure fluid from the output port toward the input port, and to a first releasing position where the check valve element moves from the valve seat toward a base end side in the axial direction and allows the flow.

In addition, it is preferable that the rod member is capable of moving in the axial direction inside the through-hole by receiving a force toward a side of the check valve element, when the seal member is moved to a residual pressure exhaust position in the connecting portion, the flow of a pressure fluid from the connecting portion of the main path toward the exhaust hole is allowed, when the check valve element is moved to a second releasing position further toward a base end side in the axial direction than the first releasing position, the flow of a pressure fluid from the second side toward the first side in the main path is allowed, the rod member is capable of moving the seal member to the residual pressure exhaust position by moving in the axial direction, and capable of moving the check valve element to the second releasing position.

In addition, it is preferable that the check valve element is provided with a first return spring that biases the check valve element toward a side of the valve seat, and the rod member is provided with a second return spring that biases the rod member toward a base end side in the axial direction.

In addition, it is preferable that the through-hole has an exhaust valve chamber on a leading end side in the axial direction, the exhaust valve chamber is provided with a piston inside the exhaust valve chamber, the piston dividing the exhaust valve chamber into a pressure chamber and a discharge chamber and being capable of sliding inside the through-hole, and the first body has a pilot port that introduces pilot pressure into the pressure chamber, and the exhaust hole that is located between the seal member and the piston and is in communication with the discharge chamber and an outside.

In addition, it is preferable that the rod member further has a piston rod that is disposed on a leading end side in the axial direction of the rod member and that is provided to be movable along the through-hole, the piston rod has a base end portion in the axial direction inserted and movable in the axial direction with respect to the piston, and when the piston rod is pressed from a third opening portion that opens at the leading end in the axial direction of the first body toward a base end side in the axial direction, the piston rod is capable of pressing the rod member to move the rod member to the base end side in the axial direction and moving the seal member to the residual pressure exhaust position and capable of moving the check valve element to the second releasing position.

In addition, it is preferable that when the axial direction is an X-axis direction, a direction orthogonal to the X-axis direction is a Z-axis direction, and a direction orthogonal to the X-axis direction and the Z-axis direction is a Y-axis direction, the first body extends in the X-axis direction, the first body is connected, on a base end side in the X-axis direction, to a second body that extends in the Z-axis direction orthogonal to the X-axis direction and that includes the output port at one end, the first body is connected, in a leading end portion in the X-axis direction, to a pilot body that is fitted around an outer periphery of the first body to be rotatable around the X-direction with respect to the first body, the first body is connected to a connecting pipe portion that is fitted around an outer periphery of the first body and rotatable around the X-axis direction further toward a base end side in the X-axis direction than the pilot body, the connecting pipe portion is connected to an annular body that is coupled and rotatable in the Y-axis direction orthogonal to the X-axis direction and the Z-axis direction, and the second body is connected to a cylindrical coupling portion that is fitted to an outer periphery of the second body and rotatable in the Z-axis direction and couples a base end portion of the first body to the second body.

Advantageous Effects of Invention

According to the present invention, it is possible to provide a pilot check valve that is capable of holding there a pressure fluid sealed downstream of a check valve element by a check function of the check valve element in case of an emergency such as stopping of power supply, even if a failure occurs in the sealing property by a valve element in a residual pressure exhaust unit.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a perspective view of a pilot check valve according to an embodiment of the present invention.

FIG. **2** is a side view of the pilot check valve.

FIG. **3** is a sectional view of the pilot check valve along line III-III of FIG. **2**.

FIG. **4** is a partial perspective view of a check valve main body.

FIG. **5** is a partial sectional view of the pilot check valve in a state where a piston rod is pressed by pilot pressure.

FIG. **6** is a partial sectional view of the pilot check valve in a state where a pressing operation is performed on the piston rod.

FIG. **7** is a circuit configuration diagram of an air pressure circuit using the pilot check valve and illustrates a state where a pressure fluid is blocked.

FIG. **8** is a circuit configuration diagram when a pressure fluid is supplied and a fluid pressure cylinder is extended from the state in FIG. **7**.

FIG. **9** is a circuit configuration diagram when a pressure fluid is supplied and the fluid pressure cylinder is contracted from the state in FIG. **7**.

DESCRIPTION OF EMBODIMENTS

Hereinafter, a pilot check valve according to the present invention will be described. In the present embodiment, a pilot check valve including three ports of an input port, an output port, and a pilot port and capable of holding residual pressure in a fluid pressure cylinder will be described. Here, a case in which a pressure fluid flowing through the pilot check valve is compressed air will be described.

FIGS. **1** to **6** illustrate an embodiment of the pilot check valve according to the present invention. A pilot check valve **10** has an input port **11** that is connected to solenoid switching valves **72** and **75** (see FIG. **7**), an output port **12** that is connected to a fluid pressure device such as a fluid pressure cylinder **80** (see FIG. **7**), a main path **13** that connects the input port **11** and the output port **12**, a check valve element **14** that is provided in the middle of the main path **13** and allows a flow of a pressure fluid from a first side in communication with the input port **11** toward a second side in communication with the output port **12**, a residual pressure exhaust path **15** that is provided further toward the input port **11** side than the check valve element **14**, a seal member **48** that is provided on the residual pressure exhaust path **15** so as to be movable and that blocks a flow from the output port **12** side toward the residual pressure exhaust path **15** side, and a pilot port **55** that introduces a pilot fluid.

The output port **12** is provided at a base end **18***b* in a direction of an axis L**1** of a body **18** having a substantially cylindrical shape elongated along the first axis L**1**. The body **18** is provided with an attachment portion **24** that is fitted to

an outer periphery of the body **18** so as to be rotatable around the axis L**1**. The attachment portion **24** is provided with a connecting pipe portion **23** that projects in a direction of a third axis L**3** orthogonal to the first axis L**1** and a second axis L**2** described later. The connecting pipe portion **23** is provided with an annular body **25** that is coupled so as to be rotatable around the axis L**3**, and the input port **11** is provided in a leading end portion in an extending direction of the annular body **25**. Details of the attachment portion **24**, the connecting pipe portion **23**, and the annular body **25** will be described later.

In addition, a check valve body **20** that has a substantially cylindrical shape and extends along the second axis L**2** orthogonal to the first axis L**1** is attached to a base end portion of the body **18**. The output port **12** opens in one end portion (lower end portion) in a direction of the axis L**2** of a main body **21** (second body) provided inside the check valve body **20**.

In addition, in a middle portion of the body **18** in the direction of the axis L**1**, the connecting pipe portion **23** that is fitted to an outer periphery of the body **18** is provided. The connecting pipe portion **23** is formed into a cylindrical shape that projects from a side surface of the body **18** and extends along the third axis L**3** orthogonal to the first and second axes L**1** and L**2**. The annular body **25** is attached to the connecting pipe portion **23**, and the input port **11** is provided in a port block **26** that is connected to one end portion of the annular body **25**.

The body **18** has a pilot body **28** having a substantially cylindrical shape, fitted to an outer periphery of a leading end **18***a* of the body **18**, and extending along the first axis L**1**. The pilot port **55** is provided in a port block **29** connected to a port forming portion **28***a* formed in the pilot body **28** and having a cylindrical shape.

The main path **13** is formed so as to reach from the input port **11** to the output port **12** of the main body **21** through the annular body **25**, the connecting pipe portion **23**, the inside of the body **18**, and the check valve body **20**. The body **18**, the check valve body **20**, the connecting pipe portion **23**, the annular body **25**, and the pilot body **28** can be formed with a metal material such as an aluminum alloy, a synthetic resin material, or the like.

Hereinafter, a configuration of the pilot check valve **10** will be described in further detail. First, the connecting pipe portion **23** has the attachment portion **24** having a cylindrical shape formed in a base end portion in the direction of the axis L**3** of the connecting pipe portion **23**. The attachment portion **24** is fitted to an outer peripheral surface of the body **18** via two O-rings **24***a* on an inner surface of the attachment portion **24** so that the attachment portion **24** and the body **18** are airtightly attached to each other.

The annular body **25** forms an elbow shape and is attached airtightly to the connecting pipe portion **23** provided on a side surface of the body **18** via an O-ring **25***a* so as to be rotatable in forward and reverse directions around the center axis (the third axis L**3**) of the connecting pipe portion **23**. The input port **11** is formed in the port block **26** attached to a leading end of the annular body **25**. In addition, a second path hole **25***b* in the annular body **25** is in communication with a connecting hole **23***a* in the connecting pipe portion **23**. The center axis of the connecting pipe portion **23**, that is, the third axis L**3** is orthogonal to both of the first axis L**1** and the second axis L**2**, and the input port **11** opens in a direction orthogonal to the third axis L**3**.

As an insertion portion **18***c* at a base end of the body **18** is inserted, via a seal member **31**, from an opening end portion side of the connecting portion **20***a* that opens on a side surface of the check valve body **20**, the body **18** is airtightly attached in a state of closing an opening end portion of the check valve body **20**. The body **18** has a through-hole **18***d* extending in the direction of the axis L**1** in the body **18**.

The check valve body **20** has the main body **21** having a cylindrical shape whose center axis is the second axis L**2** and a cylindrical coupling portion **22** fitted to an outer periphery of the main body **21**. The cylindrical coupling portion **22** is fitted to the main body **21** via an O-ring (not illustrated) on an inner surface of the cylindrical coupling portion **22** so as to be rotatable with respect to the main body **21**, as a result of which the cylindrical coupling portion **22** is coupled to the main body **21** so as to be rotatable in both forward and reverse directions around the second axis L**2**. Therefore, the body **18**, the annular body **25**, the pilot body **28**, and the like are rotatable around the second axis L**2** with respect to the main body **21**.

In the main body **21**, at a position of one end portion (lower end portion) of the second axis L**2** of the main body **21**, a connecting portion **21***a* that is directly fitted and connected to an attachment hole of a fluid pressure device is formed, the output port **12** is formed inside the connecting portion **21***a*, and a recess and a projection are provided on an outer periphery of the connecting portion **21***a*. Note that the connecting portion **21***a* may be a male screw, and may also be configured to be connected to the fluid pressure device via a pipe. In addition, in the main body **21**, a second flow hole **21***b* extending in the direction of the axis L**2** from the output port **12** is formed, and a plurality of branch holes **21***c* in communication with the second flow hole **21***b* and extending in a radial direction is also formed. The plurality of branch holes **21***c* is in communication with a second annular path **20***b* formed between an inner periphery of the cylindrical coupling portion **22** and an outer periphery of the main body **21**, the second annular path **20***b* is in communication with a third communication hole **20***c* formed in the cylindrical coupling portion **22** of the check valve body **20**.

In the insertion portion **18***c*, a check valve chamber **33** that is a part of the through-hole **18***d* and extends in the direction of the axis L**1** is formed. The check valve chamber **33** is in communication with the third communication hole **20***c* of the check valve body **20**. A spring support portion **34** is inserted and attached to a base end portion of the check valve chamber **33** in the direction of the axis L**1**. The spring support portion **34** is formed into a columnar shape, a communication hole **34***a* (second opening portion) that passes through the spring support portion **34** in the direction of the axis L**1** is formed inside the spring support portion **34**, and a plurality of cut-away holes **34***b* provided at an interval in a circumferential direction is formed on an outer peripheral portion of the spring support portion **34**. In addition, in a base end portion of the spring support portion **34** in the direction of the axis L**1**, a step portion **34***c* projecting outward in a radial direction and annularly extending is formed, and one end portion of a first return spring **36** abuts on the step portion **34***c* and is locked.

A first annular path **32** (first opening portion) that surrounds the body **18** is formed between an inner peripheral surface of the attachment portion **24** of the connecting pipe portion **23** attached to the body **18** and the outer peripheral surface of the body **18**. The first annular path **32** is in communication with the connecting hole **23***a* of the connecting pipe portion **23** and is also in communication with a plurality of first communication holes **35** extending in a radial direction in the body **18**. The first communication holes **35** are in communication with the check valve cham-

ber **33** adjacent to a central hole **37** through the central hole **37** (connecting portion) formed in a central portion of the body **18** and extending in the direction of the axis L**1**. The central hole **37** forms a part of the through-hole **18***d*. A valve seat **38** having an annular shape and surrounding the central hole **37** is formed on a boundary between the check valve chamber **33** and the central hole **37**.

In the check valve chamber **33**, the check valve element **14** is supported by the first return spring **36** attached between the check valve element **14** and the spring support portion **34**, and thus the check valve element **14** is provided so as to be displaceable in the direction of the axis L**1**. The check valve element **14** is formed having a valve plate portion **14***a* having a disk shape and a projection portion **14***b* projecting from a leading end of the valve plate portion **14***a* in the direction of the axis L**2**. One end portion of the first return spring **36** is locked to the spring support portion **34**, and another end portion of the first return spring **36** is locked to the projection portion **14***b*. The check valve element **14** opens and closes the main path **13** connecting the input port **11** and the output port **12** as the valve plate portion **14***a* comes into contact with and is separated from the valve seat **38**. By the first return spring **36**, the check valve element **14** is always biased toward a check position (see FIG. **3**) where the check valve element **14** is seated on the valve seat **38**.

With respect to a flow in a forward direction of a pressure fluid from the input port **11** toward the output port **12** side through the main path **13**, the check valve element **14** is pushed by this flow, moves to a first releasing position P**1** (see FIG. **5**) where the check valve element **14** is separated from the valve seat **38** while compressing the first return spring **36**, and releases the main path **13** to allow the flow of the pressure fluid in the forward direction. On the other hand, with respect to a flow in a reverse direction, which is a flow from the output port **12** toward the input port **11** side, the check valve element **14** is pushed by this flow and a biasing force of the first return spring **36**, moves to a check position P**2** (see FIG. **3**) where the check valve element **14** is seated on the valve seat **38**, and closes the main path **13** to block the flow of the pressure fluid in the reverse direction. That is, the state of the check valve element **14** described above is a state of "function turned on" in which the check valve element **14** can exhibit its original check function.

In the body **18**, a residual pressure exhaust valve hole **42** that is a part of the through-hole **18***d*, is in communication with the central hole **37**, and extends toward a base end side in the direction of the axis L**1** is formed, and in the residual pressure exhaust valve hole **42**, a push rod **45** (operation unit) is accommodated so as to be slidable in the direction of the axis L**1**. A gap **43** through which air can pass is formed between an outer surface of the push rod **45** and an inner surface of the residual pressure exhaust valve hole **42**, and the gap **43** forms a residual pressure exhaust path **15** extending in the direction of the axis L**1**. The residual pressure exhaust path **15** is in communication with the central hole **37**. That is, the residual pressure exhaust path **15** extends from the central hole **37** to the leading end side in the direction of the axis L**1**.

The push rod **45** has a rod portion **45***a* and a pressing portion **45***b* having a small-diameter shaft shape and extending from a base end in the direction of the axis L**1** of the rod portion **45***a*, and a leading end of the pressing portion **45***b* faces the check valve element **14** in the central hole **37**. A ring groove **45***d* (seal portion) is formed into an annular shape in a leading end portion of the rod portion **45***a*, and a seal member **48** (seal portion) is accommodated in the ring groove **45***d*.

The seal member **48** is formed into an annular shape and has a lip portion **48***a* that is inclined outward in a radial direction toward the leading end side in the direction of the axis L**1**. A leading end portion of the lip portion **48***a* is pressed against an inner surface of the residual pressure exhaust valve hole **42**, closes the residual pressure exhaust path **15**, and blocks a flow of a pressure fluid from the leading end side to the base end side in the direction of the axis L**1**. That is, in a state where the seal member **48** is pressed against the inner surface of the residual pressure exhaust valve hole **42**, the residual pressure exhaust path **15** is blocked. When the seal member **48** is displaced as the push rod **45** moves toward the base end side in the axis direction and the seal member **48** moves to a residual pressure exhaust position P**3** where the central hole **37** is located, the lip portion **48***a* is separated from a base end in the axis direction of the residual pressure exhaust valve hole **42** and opens the residual pressure exhaust path **15**. At the same time, the lip portion **48***a* is accommodated in the central hole **37** in a state where a flow of the pressure fluid is possible without closing the central hole **37** (see FIG. **5**).

A flange portion **45***c* projecting outward in a radial direction and having an annular shape is formed in a leading end portion in the direction of the axis L**1** of the rod portion **45***a* of the push rod **45**. In addition, a spring accommodating groove **42***a* having an inner diameter larger than the outer diameter of the rod portion **45***a* is formed on a leading end side in the direction of the axis L**1** of the residual pressure exhaust valve hole **42**, and a step portion **42***b* extending in a radial direction and having an annular shape is formed at a base end in the direction of the axis L**1** of the spring accommodating groove **42***a*. In addition, a second return spring **50**, which is a compression coil spring, is provided between the flange portion **45***c* and the step portion **42***b* of the spring accommodating groove **42***a* in a state where the rod portion **45***a* is inserted into the second return spring **50** and the second return spring **50** is accommodated in the spring accommodating groove **42***a*. By the second return spring **50**, the push rod **45** is always biased toward the leading end side in the direction of the axis L**1**. Note that an outer diameter of the flange portion **45***c* is slightly smaller than an inner diameter of the spring accommodating groove **42***a*. Accordingly, the flange portion **45***c* can move inside the spring accommodating groove **42***a* in the direction of the axis L**1**.

The pilot body **28** attached to a leading end portion of the body **18** has an attachment portion **28***b* having a cylindrical shape and attached to an outer peripheral surface of a base end portion of the body **18**, and a port forming portion **28***a* having an annular shape and projecting from a side surface of the attachment portion **28***b*. By fitting a locking step portion having an annular shape formed in the leading end portion of the body **18** into a recessed groove annularly shaped on an inner peripheral surface of the attachment portion **28***b*, the pilot body **28** is attached so as to be prevented from coming off the body **18** and rotatable around the axis L**1**.

In the inner peripheral surface of the attachment portion **28***b*, a residual pressure exhaust communication hole **28***c* in communication with the residual pressure exhaust valve hole **42** is formed in the direction of the axis L**1**. An inner diameter of the residual pressure exhaust communication hole **28***c* is larger than that of the residual pressure exhaust valve hole **42**, and an exhaust valve chamber **30** is formed

inside the residual pressure exhaust communication hole **28***c*. In the exhaust valve chamber **30**, a piston **51** that divides the exhaust valve chamber **30** into a pressure chamber **30***a* and an exhaust chamber **30***b* and that is capable of sliding in the direction of the axis L**1** inside the residual pressure exhaust communication hole **28***c* is provided. A gap through which air can pass is formed between an outer surface of the piston **51** on an outer side in a radial direction and an inner surface of the residual pressure exhaust communication hole **28***c*. The gap forms the residual pressure exhaust path **15** (see FIG. **5**) extending in the direction of the axis L**1**. The residual pressure exhaust path **15** is in communication with the pressure chamber **30***a* and the exhaust chamber **30***b*.

A recessed groove having an annular shape extending in a circumferential direction is formed on an outer peripheral surface of the piston **51**, and a seal member **53** that seals a space between the outer peripheral surface of the piston **51** and an inner peripheral surface of the residual pressure exhaust communication hole **28**C is attached inside the recessed groove. The seal member **53** has a lip-type structure similar to the seal member **48** described above, but differs in the direction of the lip portion **48***a*. A lip portion **53***a* of the seal member **53** is inclined outward in a radial direction toward the leading end side in the direction of the axis L**1**. As a result, the lip portion **53***a* allows a flow of a pressure fluid from the base end side toward the leading end side in the direction of the axis L**1** while blocking a flow of a pressure fluid from the leading end side to the base end side in the direction of the axis L**1**.

A recessed groove **51***a* that is recessed toward the leading end side is formed in a base end portion of the piston **51**, and the flange portion **45***c* of the push rod **45** is accommodated in the recessed groove **51***a* in a state of abutting on the recessed groove **51***a*. The depth of the recessed groove **51***a* is substantially the same as the thickness of the flange portion **45***c*. A base end surface of the piston **51** is formed into an annular shape around the axis L**1** and extends in a direction orthogonal to the direction of the axis L**1**. When the base end surface of the piston **51** abuts on a leading end surface of the body **18**, these surfaces abut on each other so that a space therebetween becomes airtight, thereby blocking the residual pressure exhaust path **15**. Therefore, a cut-away hole **19** illustrated in FIG. **4** is provided in the leading end portion of the body **18**. With the cut-away hole **19**, the residual pressure exhaust path **15** can be brought into a communication state even when the base end surface of the piston **51** abuts on the leading end surface of the body **18**.

In a central portion of the piston **51**, a through-hole **51***b* that passes through the piston **51** in the direction of the axis L**1** is provided. By fitting a base end portion of the piston rod **54** into the through-hole **51***b* via an O-ring **54***a* attached to the base end portion of the piston rod **54** in the direction of the axis L**1**, the piston rod **54** is airtightly attached to the through-hole **51***b* of the piston **51**. Note that the piston rod **54** is fitted to the through-hole **51***b* of the piston **51** so as to be slidable in the direction of the axis L**1** (see FIG. **5**).

A cover member **60** having a cylindrical shape is attached to the residual pressure exhaust communication hole **28***c* on a leading end side of the attachment portion **28***b*. The cover member **60** is inserted from an opening portion **28***e* (third opening portion) that opens at a leading end of the residual pressure exhaust communication hole **28***c* in the axis direction and is fitted to the residual pressure exhaust communication hole **28***c* via an O-ring **61** attached to a base end portion in the direction of the axis L**1** of the cover member **60**, as a result of which the cover member **60** is airtightly attached to the residual pressure exhaust communication hole **28***c*. In addition, a plurality of step portions is formed on an outer peripheral surface of the cover member **60**. As the step portions are caused to abut on engagement steps formed on an inner surface of the residual pressure exhaust communication hole **28***c*, the cover member **60** is attached to the attachment portion **28***b* in a state where the position of the cover member **60** is determined in the direction of the axis L**1**. Moreover, as locking projections formed on the outer peripheral surface of the cover member **60** are caused to be engaged with engagement recessed portions formed on the inner surface of the residual pressure exhaust communication hole **28***c*, the cover member **60** is attached to the attachment portion **28***b* in a state where the cover member **60** can be prevented from coming off.

The port forming portion **28***a* formed on a side surface of the attachment portion **28***b* is formed into a cylindrical shape extending in a direction orthogonal to the axis L**1**, and the pilot port **55** is formed in the port block **29** inserted into an opening portion on one end side of the port forming portion **28***a*. A communication hole **28***d* is formed in a bottom portion of the port forming portion **28***a*, and the communication hole **28***d* is in communication with the pressure chamber **30***a*. The communication hole **28***d* is an orifice whose cross-sectional area is decreased, and pilot pressure to be introduced into the pressure chamber **30***a* can be increased.

In addition, an exhaust hole **56** in communication with the exhaust chamber **30***b* is formed in the attachment portion **28***b*. The exhaust hole **56** discharges air in the exhaust chamber **30***b* to the outside as the piston **51** moves toward the leading end side in the direction of the axis L**1**, and at the same time, the exhaust hole **56** can discharge residual pressure in a fluid pressure cylinder **80** (see FIG. **7**), as will be described in detail later.

In the pilot check valve **10** configured as described above, when a pilot fluid is introduced from the pilot port **55** to the pressure chamber **30***a*, the piston **51** is pressed toward the base end side in the direction of the axis L**1**, the push rod **45** is moved toward the base end side against the bias of the second return spring **50**, and in addition, a leading end portion of the push rod **45** abuts on the check valve element **14**, and the valve element **14** is moved toward the base end side in the direction of the axis L**1** against the bias of the first return spring **36**. Note that in this state, the seal member **48** is located further toward the base end side in the direction of the axis L**1** than the central hole **37** and closes the residual pressure exhaust path **15**. Accordingly, since the check valve element **14** is separated from the valve seat **38** and releases the main path **13**, a flow of a pressure fluid from the input port **11** toward the output port **12** side is allowed.

Next, a fluid pressure circuit in a case where a fluid pressure device (the fluid pressure cylinder **80**) is controlled using the pilot check valve **10** will be described.

FIG. **7** illustrates an example of a fluid pressure circuit in a case where the fluid pressure cylinder **80**, which is an example of a fluid pressure device, is controlled. The fluid pressure circuit supplies a pressure fluid discharged from a pressure fluid source **71** to the two solenoid switching valves **72** and **75**, and pilot check valves **10***a* and **10***b* are connected between the fluid pressure cylinder **80** and the two solenoid switching valves **72** and **75**, respectively. The two pilot check valves **10***a* and **10***b* have the same configuration. In addition, one of the two solenoid switching valves **72** and **75** is the direction switching solenoid valve **72** that switches an expansion direction of the fluid pressure cylinder **80**, and the other is the pilot pressure supply solenoid valve **75** that

supplies pilot pressure to the pilot check valves **10***a* and **10***b*. The direction switching solenoid valve **72** is a three-position five-port type switching valve. The pilot pressure supply solenoid valve **75** is a two-position five-port type switching valve. The solenoid valves **72** and **75** have a detent function capable of holding switching positions (**101**, **102**, and **201**).

Hereinafter, the fluid pressure circuit will be described in further detail. FIGS. **1** to **6** are referred to for specific configurations of the symbolized two pilot check valves **10***a* and **10***b*.

As illustrated in FIG. **7**, input ports P of the direction switching solenoid valve **72** and the pilot pressure supply solenoid valve **75** are connected to the pressure fluid source **71** through a supply path **73**. A first output port A**1** of the direction switching solenoid valve **72** is connected to the input port **11** of the first pilot check valve **10***a* through a first output path **74**, and a second output port A**2** of the direction switching solenoid valve **72** is connected to the input port **11** of the second pilot check valve **10***b* through a second output path **76**. In addition, the output port **12** of the first pilot check valve **10***a* is connected to a head-side port **83** of the fluid pressure cylinder **80** through a first communication path **77**, and the output port **12** of the second pilot check valve **10***b* is connected to a rod-side port **82** of the fluid pressure cylinder **80** through a second communication path **84**.

Moreover, the pilot port **55** of the first pilot check valve **10***a* is connected to a first output port B**1** of the pilot pressure supply solenoid valve **75** through a first pilot supply path **86**, and the pilot port **55** of the second pilot check valve **10***b* is connected to the first output port B**1** through a second pilot supply path **87** and the first pilot supply path **86**. The second pilot supply path **87** branches off from the first pilot supply path **86** and is connected to the pilot port **55** of the second pilot check valve **10***b*.

The fluid pressure circuit illustrated in FIG. **7** indicates a state in which since the pressure fluid source **71** is blocked from the fluid pressure circuit, a pressure fluid is not supplied, the direction switching solenoid valve **72** is located at an initial position that holds a neutral position **100**, and the pilot pressure supply solenoid valve **75** is located at an initial position that holds a first switching position **200** where pilot pressure is not supplied. At this time, since pilot fluid is not supplied, the check valve elements **14** of both of the first pilot check valve **10***a* and the second pilot check valve **10***b* are in the state of "function turned on" in which the check valve elements **14** can exhibit the check function, and the seal member **48** closes the residual pressure exhaust path **15** (see FIG. **3**). Accordingly, since the main path **13** is closed by the check valve elements **14** of the first pilot check valve **10***a* and the second pilot check valve **10***b*, pressure fluids in a head-side pressure chamber **88** and a rod-side pressure chamber **89** of the fluid pressure cylinder **80** are sealed as they are.

From the state described above, as illustrated in FIG. **8**, when the pressure fluid source **71** is connected to the fluid pressure circuit, and the direction switching solenoid valve **72** is switched to a first switching position **101** after a first solenoid **72***a* of the direction switching solenoid valve **72** is excited, a pressure fluid from the pressure fluid source **71** is supplied to the input port P of the direction switching solenoid valve **72** through the supply path **73**, and, at the same time, is supplied to the input port **11** of the first pilot check valve **10***a* through the first output path **74**.

In addition, when the pressure fluid source **71** is connected to the fluid pressure circuit, and the pilot pressure supply solenoid valve **75** is switched to a second switching position **201** after a first solenoid **75***a* of the pilot pressure supply solenoid valve **75** is excited, a pressure fluid from the pressure fluid source **71** is supplied to the input port P of the pilot pressure supply solenoid valve **75** through the supply path **73** and is supplied to the pilot port **55** of the first pilot check valve **10***a* through the first pilot supply path **86**. Accordingly, the first pilot check valve **10***a* enters a state of "function turned off" in which the first pilot check valve **10***a* introduces a pilot fluid from the pilot port **55** into the pressure chamber **30***a*, moves the push rod **45** via the piston **51**, and opens the main path **13** by the check valve element **14** (see FIG. **5**).

As a result, the pressure fluid supplied to the input port **11** of the first pilot check valve **10***a* is discharged from the output port **12** through the main path **13** of the first pilot check valve **10***a* and introduced into the head-side pressure chamber **88** of the fluid pressure cylinder **80**.

On the other hand, in the second pilot check valve **10***b*, as a pilot fluid is supplied to the pilot port **55** from the first pilot supply path **86** through the second pilot supply path **87**, the second pilot check valve **10***b* enters the state of "function turned off", and the main path **13** is opened. Accordingly, the pressure fluid in the rod-side pressure chamber **89** of the fluid pressure cylinder **80** is discharged to the outside through the second communication path **84**, the output port **12** of the second pilot check valve **10***b*, the main path **13**, the input port **11**, the second output path **76**, and the direction switching solenoid valve **72**. As a result, the fluid pressure cylinder **80** extends as illustrated in FIG. **8**.

Next, for holding the extended state of the fluid pressure cylinder **80**, as illustrated in FIG. **7**, the direction switching solenoid valve **72** is switched to the neutral position **100**, and the pilot pressure supply solenoid valve **75** is also switched to the first switching position **200**. When the direction switching solenoid valve **72** is switched to the neutral position **100** and the pilot pressure supply solenoid valve **75** is also switched to the first switching position **200**, the check valve element **14** of the first pilot check valve **10***a* is pushed by a pressure fluid that is trying to flow in a reverse direction and a return movement of the first return spring **36** and thus is seated on the valve seat **38**, and closes the main path **13** so as to exhibit the check function. Therefore, the pressure fluid in the head-side pressure chamber **88** of the fluid pressure cylinder **80** is sealed in the head-side pressure chamber **88** as it is. In addition, the pressure fluid in the rod-side pressure chamber **89** of the fluid pressure cylinder **80** is also sealed in the rod-side pressure chamber **89** as it is. Therefore, the fluid pressure cylinder **80** is held at the extended position.

In addition, for contracting the fluid pressure cylinder **80**, as illustrated in FIG. **9**, a second solenoid **72***b* of the direction switching solenoid valve **72** is excited so as to switch the direction switching solenoid valve **72** to the second switching position **102**, and the first solenoid **75***a* of the pilot pressure supply solenoid valve **75** is also excited so as to switch the pilot pressure supply solenoid valve **75** to the second switching position **201**. As a result, actions of the first pilot check valve **10***a* and the second pilot check valve **10***b* are mutually reversed from the case of extending the fluid pressure cylinder **80**, a pressure fluid is supplied from the direction switching solenoid valve **72** to the rod-side pressure chamber **89** of the fluid pressure cylinder **80** through the second pilot check valve **10***b*, and at the same time, the pressure fluid in the head-side pressure chamber **88** is discharged from the first pilot check valve **10***a* through a first discharge port E**1** of the direction switching solenoid valve **72**, and the fluid pressure cylinder **80** is contracted and returns to the initial position.

The above description is an example of a case where the fluid pressure circuit normally operates. However, in an abnormal situation such as a case in which the fluid pressure cylinder **80** is extended as in FIG. **8**, power feeding to the direction switching solenoid valve **72** and the pilot pressure supply solenoid valve **75** is interrupted, and a failure occurs in the seal property of the seal member **48** of the first pilot check valve **10***a*, thereby losing the check function, supply of a pilot fluid from the pilot port **55** is stopped, and introduction of a compressed fluid from the input port **11** is also stopped. Therefore, the push rod **45** moves toward the leading end side in the direction of the axis L**1** by a return movement of the second return spring **50** and the pressure fluid flowing through the residual pressure exhaust path **15**.

As a result, since the push rod **45** is moved toward the leading end side in the direction of the axis L**1**, the check valve element **14** illustrated in FIG. **3** is pushed by a pressure fluid trying to flow in a reverse direction and a return movement of the first return spring **36** and is seated on the valve seat **38**, and enters the state of "function turned on" in which the check valve element **14** closes the main path **13** and exhibits the check function. As a result, the pressure fluid in the head-side pressure chamber **88** of the fluid pressure cylinder **80** can be sealed in the head-side pressure chamber **88** as it is.

On the other hand, since the second pilot check valve **10***b* is also in a state where power feeding is interrupted, no pilot fluid is supplied. Therefore, since the push rod **45** is pressed by a return movement of the second return spring **50** and is moved toward the leading end side in the direction of the axis L**1**, the check valve element **14** illustrated in FIG. **3** is pushed by a pressure fluid trying to flow in a reverse direction and a return movement of the first return spring **36** and is seated on the valve seat **38**, and enters the state of "function turned on" in which the check valve element **14** closes the main path **13** and exhibits the check function. Therefore, the pressure fluid in the rod-side pressure chamber **89** of the fluid pressure cylinder **80** can be sealed in the rod-side pressure chamber **89** as it is.

As a result, since the fluid pressure cylinder **80** is maintained at the extended position, malfunction of the fluid pressure device connected to the fluid pressure cylinder **80** can be prevented. Note that even when a failure occurs in the sealing property of the seal member **48** of the second pilot check valve **10***b*, or when a failure occurs in the sealing property of each of the seal members **48** of both of the first and second pilot check valve **10***a* and **10***b*, since the case in which the seal member **48** of the first pilot check valve **10***a* is damaged as described above applies, the description thereof will be omitted.

In this manner, since the pilot check valves **10***a* and **10***b* of the present embodiment are configured to exhibit the check function in which the check valve element **14** closes the main path **13** in case of an emergency such as stopping of power supply to the direction switching solenoid valve **72** and the pilot pressure supply solenoid valve **75** even when a failure occurs in the sealing property by the seal member **48**, pressure fluid (residual pressure) is able to be held as it is in each of the head-side and rod-side pressure chambers **88** and **89** of the fluid pressure cylinder **80**.

Here, when it is desired to exhaust the residual pressure held in the fluid pressure cylinder **80** from the fluid pressure cylinder **80**, in a state where the direction switching solenoid valve **72** is switched to the neutral position **100** and the pilot pressure supply solenoid valve **75** is switched to the first switching position **200**, as illustrated in FIG. **5**, each piston rod **54** of the pilot check valves **10***a* and **10***b* shall be pressed toward the base end side in the direction of the axis L**1**.

After the piston rod **54** is pressed, as illustrated in FIG. **6**, the piston rod **54** moves toward the base end side in the direction of the axis L**1**, and the piston **51** and the push rod **45** also move toward the base end side in the direction of the axis L**1**. Then, the piston **51** abuts on the leading end portion of the body **18** in the axis direction and is prevented from moving. In addition, the push rod **45** moves toward the base end side in the direction of the axis L**1** with respect to the piston **51** and moves the check valve element **14**, via the push rod **45**, to a second releasing position P**4** located further toward the base end side in the direction of the axis L**1** than the first releasing position P**1**. In addition, at the same time, the seal member **48** moves to the central hole **37**. As a result, while the check valve element **14** is separated from the valve seat **38** and releases the main path **13**, the seal member **48** releases the residual pressure exhaust path **15**. Therefore, since the output port **12** is in communication with the pilot port **55** and the exhaust hole **56** through the main path **13** and the residual pressure exhaust path **15**, the residual pressure in the head-side pressure chamber **88** of the fluid pressure cylinder **80** can be discharged to the outside through the first pilot check valve **10***a*. In addition, in the same manner as described above, the residual pressure in the rod-side pressure chamber **89** of the fluid pressure cylinder **80** can be discharged to the outside through the second pilot check valve **10***b*.

Note that in the pilot check valve **10** according to the present embodiment, the pilot body **28** having the pilot port **55** is rotatable around the axis L**1** (X-axis) with respect to the body **18**, the connecting pipe portion **23** is rotatable around the axis L**1** with respect to the body **18**, the annular body **25** is rotatable around the axis L**3** (Y-axis) with respect to the connecting pipe portion **23**, and the cylindrical coupling portion **22** is rotatable around the axis L**2** (Z-axis) with respect to the main body **21**. Therefore, the degree of freedom of arrangement directions of pipes to be connected to ports connected to these bodies can be enhanced.

REFERENCE SIGNS LIST

10, **10***a*, **10***b* Pilot Check Valve
11 Input Port
12 Output Port
13 Main Path
14 Check Valve Element
15 Residual Pressure Exhaust Path
18 Body (First Body)
18*d* Through-Hole
28*e* Opening Portion (Third Opening Portion)
30 Exhaust Valve Chamber
30*a* Pressure Chamber
30*b* Exhaust Chamber
32 First Annular Path (First Opening Portion)
34*a* Communication Hole (Second Opening Portion)
36 First Return Spring
37 Central Hole (Connecting Portion)
45 Push Rod (Operation Unit)
45*d* Ring Groove (Seal Portion, Recessed Groove)
48 Seal Member (Seal Portion)
50 Second Return Spring
51 Piston
54 Piston Rod
55 Pilot Port
56 Exhaust Hole
L**1** First Axis (X-Axis)

P1 First Releasing Position
P2 Check Position
P3 Residual Pressure Exhaust Position
P4 Second Releasing Position

The invention claimed is:

1. A pilot check valve comprising:
a first body that has an input port and an output port;
a main path that is provided in the first body and is in communication with the input port and the output port;
a check valve element that is provided in the main path and allows a flow of a pressure fluid from a first side in communication with the input port toward a second side in communication with the output port, the check valve element being selectively moved, by supply or discharge of a pilot fluid, to a position where a flow from the output port toward the input port is blocked and a position where the flow is allowed;
a residual pressure exhaust path having one end connected to a connecting portion formed on the first side of the main path and another end connected to an exhaust hole provided and opened on the first body;
a seal portion that is provided in the residual pressure exhaust path and blocks a flow of a pressure fluid from the connecting portion of the main path toward a side of the exhaust hole; and
an operation unit that is capable of moving the check valve element to a position where a flow of a pressure fluid from the second side toward the first side in the main path is allowed and moving the seal portion to a position where the flow of a pressure fluid from the connecting portion of the main path in the residual pressure exhaust path toward the exhaust hole is allowed.

2. The pilot check valve according to claim 1, wherein
the first body extends in an axial direction, is formed into a cylindrical shape, and has a base end and a leading end at both ends in the axial direction,
the first body has a through-hole that extends inside in the axial direction,
the first body has a first opening portion that opens in a middle portion of the first body in the axial direction and that is in communication with the input port, and a second opening portion that opens in a base end portion of the first body in the axial direction and that is in communication with the output port,
the check valve element is supported and is movable in the axial direction in a base end portion in the axial direction of the through-hole extending in the axial direction, and
the operation unit is accommodated in the through-hole further toward a leading end side than the check valve element in the axial direction and is movable in the axial direction.

3. The pilot check valve according to claim 2, wherein
the operation unit is a rod member that extends along the through-hole,
the rod member has an outer diameter that is smaller than an inner diameter of the through-hole, and
the residual pressure exhaust path is formed of a gap formed between an outer peripheral surface of the rod member and an inner peripheral surface of the through-hole.

4. The pilot check valve according to claim 3, wherein
the seal portion has a recessed groove that is formed into an annular shape on the outer peripheral surface of the rod member, and a seal member that is accommodated in the recessed groove, and
the seal member is a lip-type seal member, the seal member having a lip portion that is formed to be inclined outward in a radial direction toward a base end side in the axial direction.

5. The pilot check valve according to claim 4, wherein
a part of the through-hole in communication with the first opening portion and the second opening portion forms a part of the main path,
the base end portion in the axial direction of the through-hole extending in the axial direction has a valve seat on which the check valve element is capable of abutting, and
the check valve element is capable of moving to a check position where the check valve element abuts on the valve seat and blocks a flow of a pressure fluid from the output port toward the input port, and to a first releasing position where the check valve element moves from the valve seat toward a base end side in the axial direction and allows the flow.

6. The pilot check valve according to claim 5, wherein
the rod member is capable of moving in the axial direction inside the through-hole by receiving a force toward a side of the check valve element,
when the seal member is moved to a residual pressure exhaust position in the connecting portion, the flow of a pressure fluid from the connecting portion of the main path toward the exhaust hole is allowed,
when the check valve element is moved to a second releasing position further toward a base end side in the axial direction than the first releasing position, the flow of a pressure fluid from the second side toward the first side in the main path is allowed,
the rod member is capable of moving the seal member to the residual pressure exhaust position by moving in the axial direction, and capable of moving the check valve element to the second releasing position.

7. The pilot check valve according to claim 6, wherein
the check valve element is provided with a first return spring that biases the check valve element toward a side of the valve seat, and
the rod member is provided with a second return spring that biases the rod member toward a leading end side in the axial direction.

8. The pilot check valve according to claim 6, wherein
the through-hole has an exhaust valve chamber on a leading end side in the axial direction,
the exhaust valve chamber is provided with a piston inside the exhaust valve chamber, the piston dividing the exhaust valve chamber into a pressure chamber and a discharge chamber and being capable of sliding inside the through-hole, and
the first body has a pilot port that introduces pilot pressure into the pressure chamber, and the exhaust hole that is located between the seal member and the piston and is in communication with the discharge chamber and an outside.

9. The pilot check valve according to claim 8, wherein
the rod member further has a piston rod that is disposed on a leading end side in the axial direction of the rod member and that is provided to be movable along the through-hole,
the piston rod has a base end portion in the axial direction inserted and movable in the axial direction with respect to the piston, and
when the piston rod is pressed from a third opening portion that opens at the leading end in the axial direction of the first body toward a base end side in the

axial direction, the piston rod is capable of pressing the rod member to move the rod member to the base end side in the axial direction and moving the seal member to the residual pressure exhaust position and capable of moving the check valve element to the second releasing position.

10. The pilot check valve according to claim **2**, wherein

when the axial direction is an X-axis direction, a direction orthogonal to the X-axis direction is a Z-axis direction, and a direction orthogonal to the X-axis direction and the Z-axis direction is a Y-axis direction,

the first body extends in the X-axis direction,

the first body is connected, on a base end side in the X-axis direction, to a second body that extends in the Z-axis direction orthogonal to the X-axis direction and that includes the output port at one end,

the first body is connected, in a leading end portion in the X-axis direction, to a pilot body that is fitted around an outer periphery of the first body to be rotatable around the X-direction with respect to the first body,

the first body is connected to a connecting pipe portion that is fitted around an outer periphery of the first body and rotatable around the X-axis direction further toward a base end side in the X-axis direction than the pilot body,

the connecting pipe portion is connected to an annular body that is coupled and rotatable in the Y-axis direction orthogonal to the X-axis direction and the Z-axis direction, and

the second body is connected to a cylindrical coupling portion that is fitted to an outer periphery of the second body and rotatable in the Z-axis direction and couples a base end portion of the first body to the second body.

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